Porcelain Laminate Veneers in 2025:

Combining Technology with Evidence-Based Clinical and Laboratory Workflows

Julian Conejo, DDS, MSc[1]
Sergio Losas, CDT[2]
Telmo Santos, CDT[3]
Markus B. Blatz, DMD, PhD[1]

Porcelain laminate veneers (PLVs) have become the standard of care for patients looking to improve their smile with indirect restorations while preserving as much healthy tooth structure as possible.[1] It is extremely important to have a good understanding of the indications, contra-indications, and best clinical/laboratory handling of milled and pressable ceramic materials to achieve highly esthetic and functional long-term clinical results.[2]

This article details two techniques for the fabrication of PLVs with the implementation of additive and subtractive digital manufacturing technologies and provides an updated review of adhesive cementation techniques with a step-by-step clinical approach.

[1]Department of Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, Philadelphia, Pennsylvania, USA.
[2]Laboratorio Dental Losas, Santo Tome, Corrientes, Argentina.
[3]Coritec, Belo Horizonte, Brazil.
Correspondence to: Julian Conejo, jconejo@upenn.edu

FIGS 1 TO 3 Initial extraoral and intraoral images taken to facilitate a facially driven treatment plan.

Case 1

A 30-year-old man presented to the clinic and reported that he was "dissatisfied with his smile" when asked about his chief complaint. After extraoral/intraoral images and diagnostic digital impressions were obtained (Figs 1 to 3), these files were shared with the dental technician through a secured online platform.

In the design software, all intraoral scans and the patient's frontal portrait photograph on high smile were aligned by matching points. This facilitates the visualization of the maxillary and mandibular arches in a 3D position similar to the patient's reality. If a face scan image is preferred, the same workflow can be followed.[3]

After a thorough dental-facial analysis, a digital wax-up from the maxillary right first premolar to maxillary left first premolar was made, following esthetic parameters. The file was then exported as an STL file, and the model was 3D printed. Following washing and curing, the sprues were removed and the model was polished with a buff wheel at low speed (6,000 rpm) to idealize the facial surface on the maxillary teeth (Figs 4 and 5). This additional step will enhance the esthetic outcome of the mock-up and provisional restorations, as a silicone matrix will transfer it into the patient's mouth.

A mock-up was completed with a bis-acryl material (Fig 6), and new photographs were taken and evaluated. Once the new smile design was presented to the patient and approved, the mock-up was used as a preparation guide.

FIGS 4 AND 5 3D-printed model of the digital wax-up after polishing to enhance the surface quality.

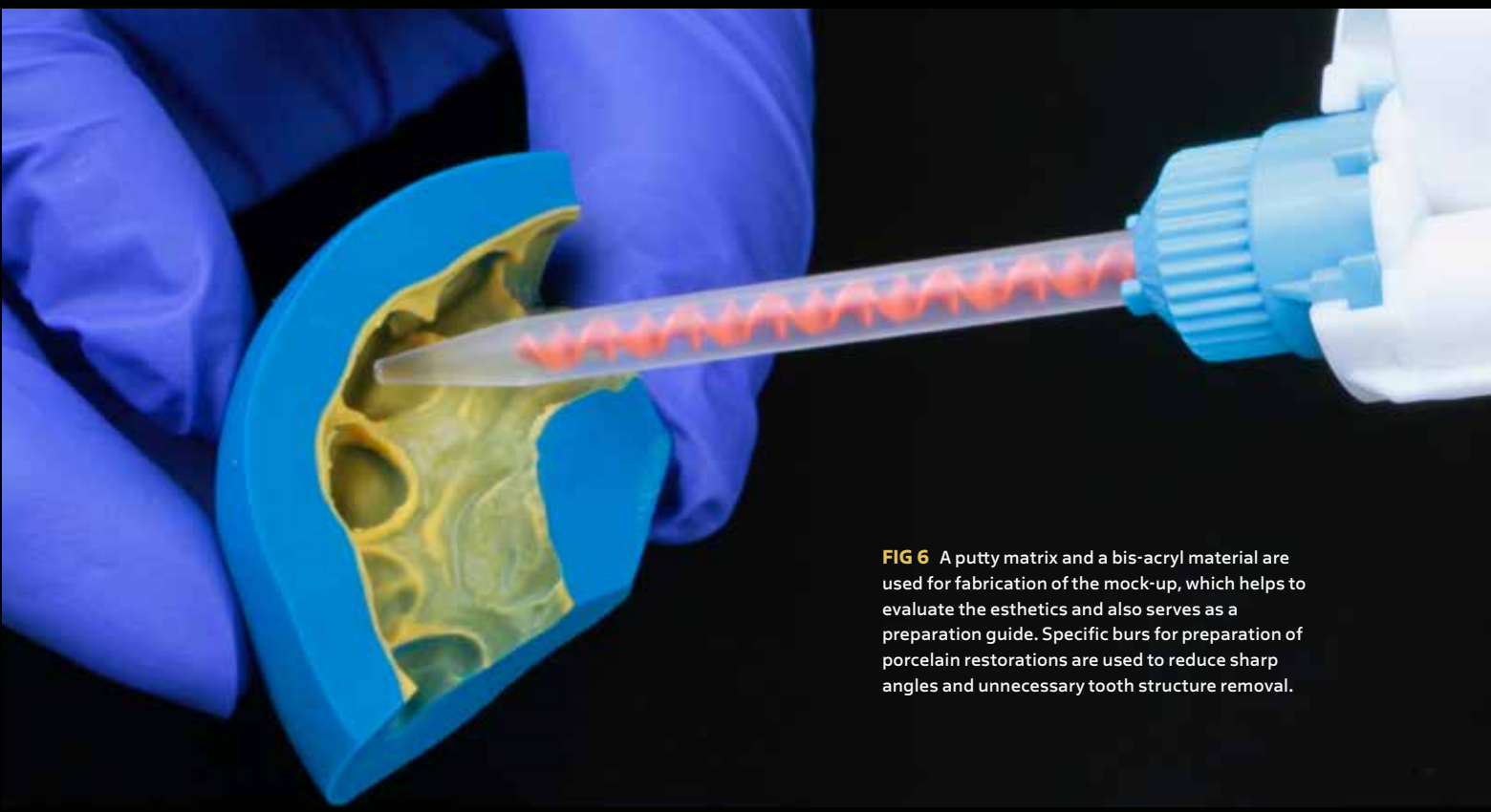
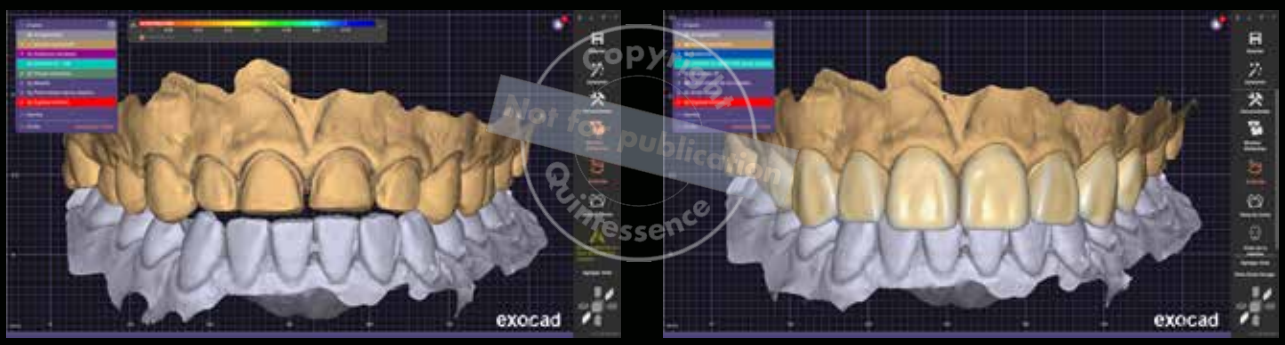


FIG 6 A putty matrix and a bis-acryl material are used for fabrication of the mock-up, which helps to evaluate the esthetics and also serves as a preparation guide. Specific burs for preparation of porcelain restorations are used to reduce sharp angles and unnecessary tooth structure removal.

A 0.3-mm depth-cutting bur was used initially to create the space for the future ceramic material. A fine-diamond chamfer bur was used to make the facial and incisal reductions and to create the finish line at the gingival level after inserting a #000 retraction cord. This preparation sequence helps to hide any tooth discolorations or tooth-restoration junctions from the esthetic zone while respecting the biologic width, as no subgingival margins will be expected.

A second retraction cord #00 in diameter was inserted for horizontal tissue displacement. The definitive digital impression was made immediately after removing the second cord from the sulcus, creating a detailed impression. At this point, files are evaluated chairside, and if needed, corrections on the preparation design are made and rescanned immediately to avoid repeating the procedure in a following appointment. In this case, new files were sent to the dental technician, and they were added to the initial case in the software. This workflow ensures that the approved wax-up design will be maintained for the definitive PLVs. After an online meeting between the clinician and dental technician, all margins are confirmed, and the final restoration design is completed (Figs 7 and 8).

A five-axis milling machine (Coritec, IMES-ICORE) was used to mill the feldspathic porcelain blocks (TriLux Forte, Vita Zahnfabrik) with an average thickness of 0.4 mm. All sprues were placed toward the facial aspect and as distant as possible from the restoration margins to reduce any risk of chipping in that area (Figs 9 and 10).



FIGS 7 AND 8 Intraoral scan files are evaluated, margins are selected, and final restorations are designed using the initial wax-up as a reference.

FIGS 9 AND 10 The PLVs are milled from multichromatic feldspathic porcelain veneers.
[Au: please provide higher resolution image for Fig 10.]

FIGS 11 TO 13 The PLVs are seated in the 3D-printed model to enhance the morphology and overall integration.

FIGS 14 AND 15 The combination of multichromatic blocks and a stain/glaze technique facilitates the fabrication of highly esthetic PLVs.

The STL file of the maxillary teeth preparations was edited to create a base and then 3D printed at high resolution. With the improved accuracy of 3D-printed resin models, the milled laminate veneers can be easily fitted to the model to evaluate the esthetics and overall integration.[4] At this point, the contours, symmetry of incisal edges, line angle position, embrasures, and surface texture are analyzed and detailed (Figs 11 to 13). After completion of minor morphologic modifications, the PLVs are stained and glazed to recreate the natural tooth characterization of the incisal third with gray, blue, and white stains (Akzent Plus, Vita Zahnfabrik). In the cervical third, yellow and pink stains were used to improve the integration with the soft tissues and resemble a thicker internal thickness of dentin. With polychromatic materials like the feldspathic porcelain blocks used, completion of this color characterization is possible with one fixation firing, followed by a glaze firing to seal any pores and protect the stains. Manual polishing of the glazed surface with fine diamond–impregnated polishing tips is the last step to recreate a natural surface luster (Figs 14 and 15).

FIGS 16 AND 17
A specific tray for holding the PLVs and a light-curing resin cement system are used.

After receiving the PLVs from the dental laboratory, they were meticulously inspected under high magnification to ensure that there was no marginal chipping or surface imperfections. A plastic container to store the PLVs during the surface treatment for adhesive cementation reduces the risk of mishandling, which could be catastrophic with feldspathic porcelain restorations due to their high glassy matrix (Figs 16 and 17).

A try-in paste was used to stabilize the PLVs in place for esthetic evaluation. After intraoral and extraoral photographs were taken and discussed with the patient for approval, the rubber dam was placed to start the adhesive cementation sequence. The feldspathic PLVs were etched with hydrofluoric acid for 60 seconds and cleaned in an alcohol ultrasonic bath for 3 minutes. After air drying, the silane coupling agent (Clearfil Ceramic Primer Plus, Kuraray) was applied.

FIGS 18 TO 23 Rubber dam isolation and a detailed adhesive cementation protocol are key to the long-term success of PLVs.

An intraoral air-abrasion unit (Aquacare) was used to clean the preparations. Phosphoric acid was applied for 20 seconds and washed away with copious water. After air drying the surface, a universal adhesive (Clearfil Universal Bond Quick, Kuraray) was placed with a microbrush and air-thinned for 5 seconds. The dual-curing properties of this adhesive makes it extremely useful for PLVs, since it is not necessary to light cure, thereby avoiding the potential risk of excessive thickness that could compromise final seating. A light-curing resin cement (Panavia Veneer LC, Kuraray) was applied to cover the intaglio surface, and the PLVs were seated. After confirming ideal positioning on each tooth preparation, any excess cement was removed with a microbrush and dental floss before light curing for 20 seconds on each surface of the tooth. The extended working time of light-curing resin cements makes cementation of PLVs less technique sensitive, avoiding misplacement[5] (Figs 18 to 23). Final views of this case are shown in Figs 24 to 26.

FIGS 24 TO 26
Final extraoral and intraoral images of the PLVs showing soft tissue and facial integration.

Case 2

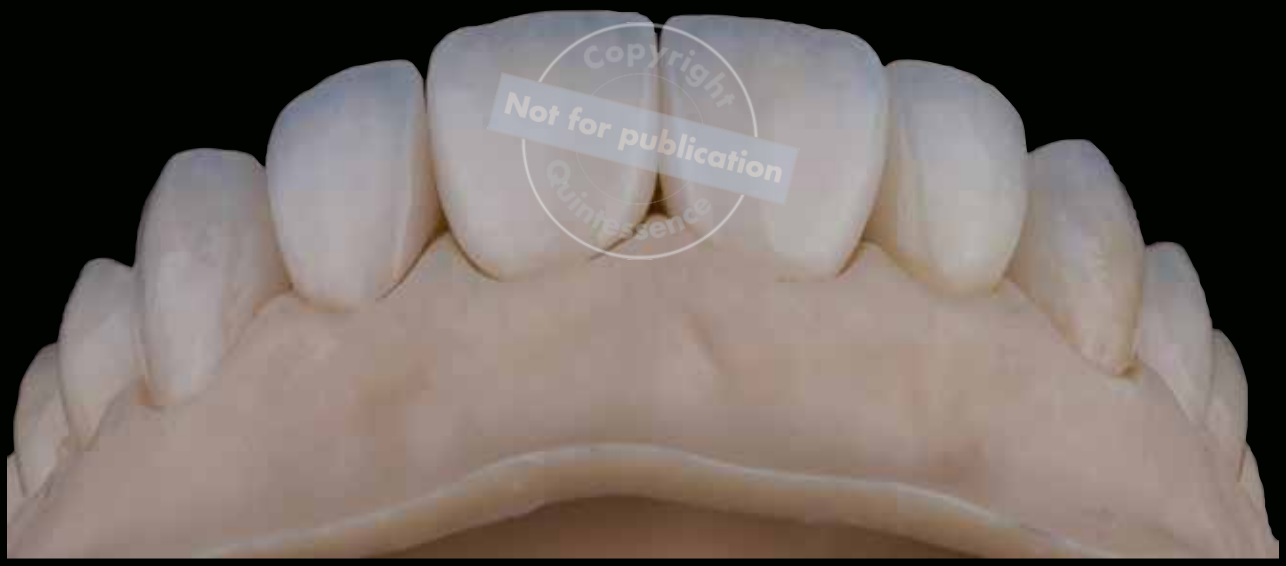
A 35-year-old woman presented to the clinic and reported that she was "worried about the condition of her front teeth" when asked about her chief complaint. After extraoral/intraoral images and diagnostic digital impressions were obtained (Figs 27 to 30), these files were shared with the dental technician. After completion of a facially driven digital wax-up, a model was 3D printed to create a mock-up on the maxillary incisors and premolars. After evaluation and approval by the patient, tooth preparations were made, followed by final intraoral digital impressions. The files were sent to the dental laboratory for design and manufacturing of definitive restorations.

In this case, the print-press technique was used, whereby the restorations are 3D printed with a castable resin (Figs 31 to 33) followed by injection of a medium-opacity silicate ceramic material (Ambria, Vita Zahnfabrik). After recovery of the pressed restorations, the sprues were removed, and the marginal adaptation was evaluated (Figs 34 and 35). When all the restorations were seated on the 3D-printed model obtained from the intraoral scan of the preparations, a stain/glaze technique was used for customization of the incisal third with blue, gray, orange, and white stains. A final glaze cycle sealed any porosities and fixated the stains[6] (Figs 36 and 37).

FIGS 27 TO 30 Initial extraoral and intraoral images taken to facilitate a facially driven treatment plan.

FIGS 31 TO 33 Final restorations are designed using the initial wax-up as a reference and the patient's portrait image to evaluate the midline and smile integration. The resin patterns are 3D printed followed by sprue placement for pressing of the definitive PLVs.

FIGS 34 AND 35 A lithium silicate material is used to press the PLVs.



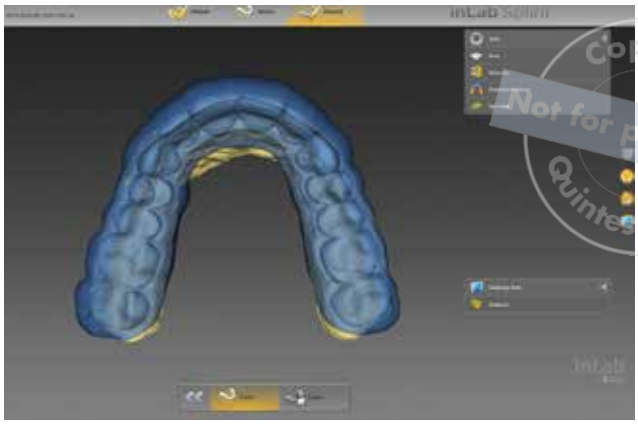
FIGS 36 AND 37
The combination of the print-press technique followed by stain/glaze is a great alternative for fabrication of highly esthetic PLVs.

A light-curing resin cement with a soft white color (Panavia Veneer LC Soft White 0.5, Kuraray) was used to augment the value of the restorations, enhancing the esthetic outcome[7] (Figs 38 and 39). The restorations were etched with hydrofluoric acid for 20 seconds, followed by the application of a silane coupling agent (Clearfil Ceramic Primer Plus) before cementation (Figs 40 to 42). After adhesive cementation, the restorations were inspected under the microscope to ensure that no excess cement was present. This step facilitates accelerated soft tissue healing and stability after the prosthetic procedure (Figs 43 to 46). New intraoral scans were made to design and mill a polymethyl methacrylate (PMMA) maxillary nightguard for protection of the restorations and adjacent teeth[8] (Figs 47 and 48). At the follow-up appointment, the patient expressed that she was very pleased and satisfied with the treatment outcome (Fig 49).

FIGS 38 AND 39
A soft-white light-curing resin cement system is used to provide a high value.

FIGS 40 TO 42 PLVs are acid etched and silanized before adhesive cementation.

FIGS 43 TO 46 Final extraoral and intraoral images of the PLVs showing soft tissue and facial integration.



FIGS 47 AND 48 A maxillary nightguard is designed and milled from a PMMA disc to protect the restorations.

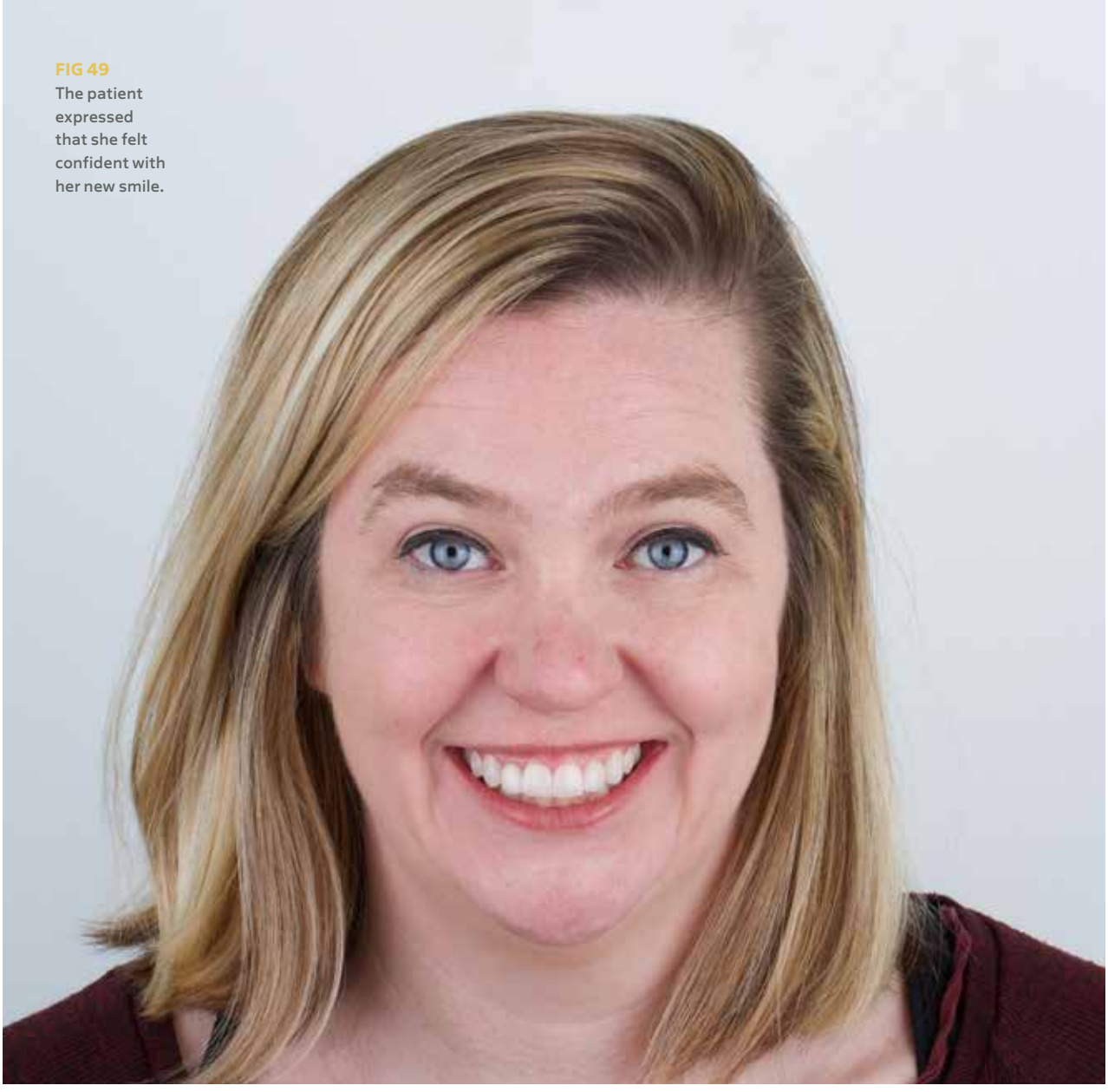


FIG 49
The patient expressed that she felt confident with her new smile.

Conclusion

Detailed treatment planning and execution in combination with the implementation of digital tools like intraoral scanners, dental design software, 3D printers, and milling machines provides a consistent outcome for PLVs from both esthetic and functional aspects. Understanding manufacturers' recommendations for material handling and adhesive protocols may lead to long-term successful clinical results. A careful selection and implementation of the latest materials and workflows may also reduce complications and remakes, as not all available resin and ceramic materials in the market have significant clinical evidence.[9]

Digitalization plays an important role in anterior esthetic restorations. The use of digital technology to manage the entire process of anterior restorations can improve restorative results, reduce the number of follow-up appointments, shorten consultation time, and achieve better patient satisfaction.[10]

References

1. Blatz MB, Conejo J. The current state of chairside digital dentistry and materials. Dent Clin North Am 2019;63:175–197.
2. Blatz MB, Alammar A, Rojas F, Conejo J. How to bond to current CAD/CAM ceramics. Compend Contin Educ Dent 2023;44:560–565.
3. Conejo J, Dayo AF, Syed AZ, Mupparapu M. The digital clone: Intraoral scanning, face scans and cone beam computed tomography integration for diagnosis and treatment planning. Dent Clin North Am 2021;65:529–553.
4. Rungrojwittayakul O, Kan JY, Shiozaki K, et al. Accuracy of 3D printed models created by two technologies of printers with different designs of model base. J Prosthodont 2020;29:124–128.
5. Blatz MB, Conejo J, Alammar A, Ayub J. Current protocols for resin-bonded dental ceramics. Dent Clin North Am 2022;66:603–625.
6. Conejo J, Santos T, Tikreeti A, Atria PJ, Blatz M. The computer aided design/press technique: Fabrication of zirconia-reinforced lithium disilicate restorations for treatment of extensive noncarious cervical lesions. J Esthet Restor Dent 2022;34:763–768.
7. Hardan L, Bourgi R, Hernández-Escamilla T, et al. Color stability of dual-cured and light-cured resin cements: A systematic review and meta-analysis of in vitro studies. J Prosthodont 2024;33:212–220.
8. Grymak A, Waddell JN, Aarts JM, Ma S, Choi JJE. Evaluation of wear behaviour of various occlusal splint materials and manufacturing processes. J Mech Behav Biomed Mater 2022;126:105053.
9. Atria PJ, Bordin D, Marti F, et al. 3D-printed resins for provisional dental restorations: Comparison of mechanical and biological properties. J Esthet Restor Dent 2022;34:804–815.
10. Liu J, Maihemaiti M, Ren L, et al. A comparative study of the use of digital technology in the anterior smile experience. BMC Oral Health 2024;24:492.